

Shifting trends in the research involvement of a younger and more global generation of scientists

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BNL P5 Townhall
Apr. 13, 2023

Needs for collaboration resonate across boundaries in Snowmass

“The current standard for S&C training is project-specific on-the-job training. These **training activities** can be very effective, especially with formalized curricula and documentation. However, these activities are often **inaccessible beyond a particular experiment or other organization** and due to **limited person-power**, these events often do **not cover as deep or as broad as is needed** to be maximally effective with S&C.” ([Computational Frontier Report](#))

“In addition to slowing advancement, it makes it **difficult to maintain a viable R&D portfolio** and threatens **student training and work-force development** in US accelerator science. **Integrated efforts are needed to mitigate** this situation and maintain at adequate levels the Beam Physics and Accelerator Science & Engineering (AS&E) education and outreach programs in the US.” ([Accelerator Frontier Report](#))

“Adapting successfully to the move to specialized computing architectures will require significant new software development since we are only in the earliest days of making use of these facilities in many neutrino experiments, as highlighted by Critical Challenge 3 in the Computing Frontier report. **Achieving this adaptation will require support for the development of both shared software solutions (Critical Challenge 2) where they are possible as well as in experiment-specific contexts.** DUNE provides examples of both: it is **already making use of some LHC-developed tools** for data movement and workflow management, which shows the possibility for sharing solutions. However, DUNE will also have specialized needs which differ from colliders” ([Neutrino Frontier Report](#))

“**Presently US funding** for advanced detector R&D is **institute-based rather than collaboration-based.** Yet collaborations are more essential than ever to leadership in detector R&D technology. To a significant extent, **funding constraints have limited the opportunity to establish significant collaborative detector R&D programs.**” ([Instrumentation Frontier Report](#))

Perspectives on career success in physics

Based on the [statistics](#) collected by the AIP for success in career ten years after PhD, “[f]lexibility and adaptability seemed to be important traits for success in PhD physicists’ careers and enabled them to take advantage of more career opportunities. Physicists stated that they were more successful when they were **willing to work in a different scientific field, research area, location, or type of position...** Flexibility also meant **broadening and diversifying their skills and interests**, rather than focusing on narrow and technical tasks.”

“Flexibility about the kind of research I am willing to do.”

“Willingness to expand into new areas of expertise, such as statistical analysis and simulation.”

“Seek (and make known that I am seeking) growth opportunities, including ones that increase my professional breadth rather than depth.”

Funding seems to be a **major organizational support mechanism**, together with **social support** and immersion in **diversity of mentors**:

“Basic research support by US government.”

“Support and collaboration with intelligent and generous colleagues.”

“Links to senior scientists that I have formed during my research career. They have taught me not only how to hone my scientific skills, but also how to promote my science and formulate clear ideas for proposals.”

Toward a more synergistic culture

Challenges in workforce development and retention that span different particle physics frontiers are also **opportunities for cross-pollination** to flourish:

- **Young researchers are willing** to participate in different projects that can benefit our community and **share the expertise they develop**.
- Such participation can help them gain a **broader perspective of our field** and make **more informed choices** about the developments of their skills and their future careers.
 - Importance felt for students in **large collaborations** where it is **easy to lose sight of the big picture** and general trends in our field
- We have the **opportunity to enable synergistic collaborative efforts** and help our future workforce gain the expertise our particle physics community needs.

Different particle physics **frontiers have common themes for needs**, and extending existing (and creating new) funding opportunities for **cross-frontier research to group these themes together** seem to be gaining more importance.

- For the **long-term sustainability** of our field, it would be vital to continue to
 - **Support training needs of our workforce** either through **dedicated schools** or enhanced **internship partnerships**, and
 - **Create funding paths that can enable academic hiring** of experts who plan to interact with **multiple frontiers**.
- **Flexibility to share** our **human power** could **lower costs** in the long term.
- We have the opportunity **today** to **start transforming how our workforce looks** in the next ten years.

Physics in the US is international.

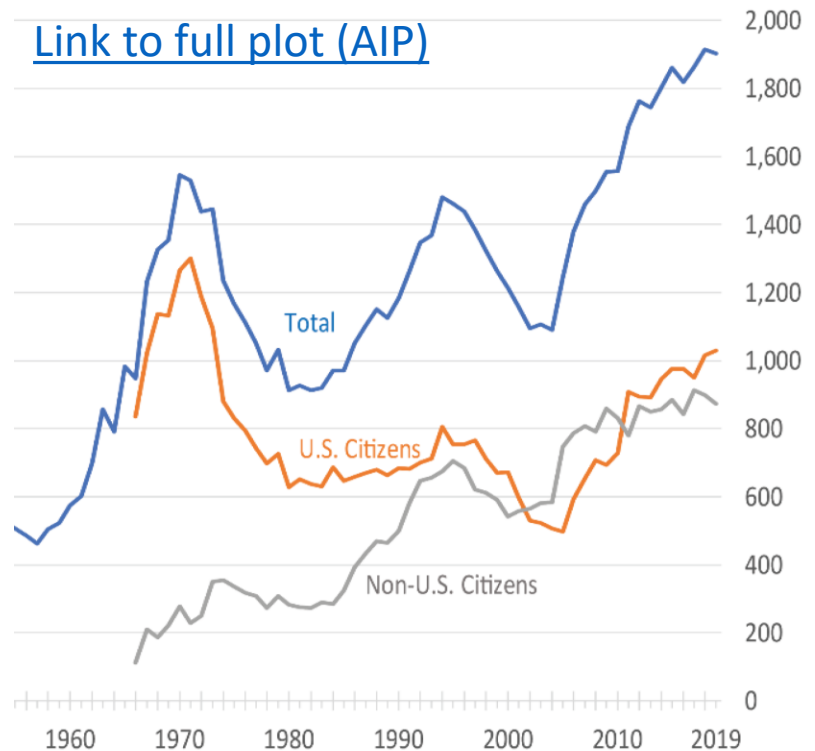
The number of **PhD recipients in the US** who are **non-US citizens** has been **almost equal** to that of **US citizens** for **more than twenty years**.

- The proportions typically exceed 50% for postdoctoral researchers.
- We keep **high retention rates**, and **workforce** considerations remain **highly international**.

In providing opportunities, we need to **keep in mind** that **international students and scholars** in the US may have **different needs** than non-US citizens:

- **Funding opportunities are not equally available to international researchers.**
- This includes **funding for training**.
- **Even when they are**, there are **non-academic concerns** that can influence their acquisition.

Number of PhD recipients in the US



Visas and immigration issues

According to the Fall '21 NSF [survey](#) of graduate students and postdocs in S&E, roughly **31% of doctoral or master's students** and **52% of postdocs** in sciences hold **temporary visa status**, and these rates have remained **stable over a decade**.

→ The typical **visa path available for postdocs** imposes **restrictions** over their **subsequent employability** in the US and **increases risks** in the **retention of their expertise**.

→ **Temporary visa** requirements can **place a barrier** in acquisition of **governmental funds**.

→ The **immigration process** also features **indeterminate delays**, and places **more financial burden** that are **not necessarily all covered by hiring institutions**.

“Postdocs also are affected more by visa restrictions compared to graduate students, and some Postdocs applying for jobs reported that immigration issues were an important concern for them. **Our results indicate that immigration issues disproportionately affect early career scientists in other racial groups, while White early career scientists remain largely unaffected. Current U.S. visa policies are largely inadequate to support Postdocs' transitions into non-academic job sectors [29].** Immigration concerns should always be taken into account while training Postdocs on how to navigate various job markets, and institutions should support their Postdocs' struggles with U.S. visas and immigration policies by advocating for updated policies and a streamlined application process.”

([Snowmass '21 Community Survey Report](#))

The **US visa and immigration policies need to adapt** for the sustainability of our increasingly international collaborative environment:

→ Even if policies cannot be changed in the short-term, **passing the message** could prevent implementations with potentially harmful consequences to our field.

→ In the meantime, it remains important to develop **alternative pathways to continue to support our international colleagues**.

Thank you!